Complete Summary

GUIDELINE TITLE

Treatment of acute myocardial infarction.

BIBLIOGRAPHIC SOURCE(S)

Institute For Clinical Systems Improvement (ICSI). Treatment of acute myocardial infarction. Bloomington (MN): Institute For Clinical Systems Improvement (ICSI); 2002 Nov. 68 p.

COMPLETE SUMMARY CONTENT

SCOPE
METHODOLOGY - including Rating Scheme and Cost Analysis
RECOMMENDATIONS
EVIDENCE SUPPORTING THE RECOMMENDATIONS
BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS
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QUALIFYING STATEMENTS
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INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES
IDENTIFYING INFORMATION AND AVAILABILITY

SCOPE

DISEASE/CONDITION(S)

Acute myocardial infarction

GUIDELINE CATEGORY

Evaluation
Management
Prevention
Rehabilitation
Risk Assessment
Treatment

CLINICAL SPECIALTY

Cardiology
Critical Care
Emergency Medicine
Family Practice

Internal Medicine
Nursing

INTENDED USERS

Advanced Practice Nurses
Allied Health Personnel
Nurses
Physician Assistants
Physicians

GUIDELINE OBJECTIVE(S)

- To minimize the delay in administering thrombolytics or angioplasty to patients with acute myocardial infarction (AMI)
- To increase the timely initiation of treatment to reduce post-infarction mortality in patients with AMI
- To increase the use of risk stratifying procedures in patients with AMI
- To increase the percentage of patients with AMI, who have used tobacco products within the past year, who receive tobacco use assessment and cessation counseling and treatment within 24 hours of admission
- To increase the percentage of patients with AMI using appropriate cardiac rehabilitation post discharge

TARGET POPULATION

- Adults 18 and older who have been diagnosed or suspected with an acute myocardial infarction (AMI)
- This guideline applies to patients seen in the emergency department or the physician's office as well as to patients who are hospitalized for another illness and develop a myocardial infarction during their hospitalization.

INTERVENTIONS AND PRACTICES CONSIDERED

Emergency Management/General Evaluation

1. 12-lead electrocardiography (ECG)
2. Cardiac monitoring
3. Supplemental oxygen
4. Establish intravenous (IV) access at two or three sites (especially if thrombolytics are to be administered)
5. Volume expansion with normal saline
6. Routine laboratory studies (electrolytes, blood urea nitrogen [BUN], creatinine, complete blood count, creatine kinase, and creatine kinase-muscle isoenzyme if elevated, troponin)
7. Intravenous or sublingual nitrates
8. Analgesics/anxiolytics, such as morphine sulfate, benzodiazepine
9. Vital signs
10. Thrombolytics, such as alteplase (rt-PA) (Activase®), anistreplase (APSAC) (Eminase®), reteplase (rPA) (Retavase®), streptokinase (Kabikinase®, Streptase®), tenecteplase (TNKase®)

11. Echocardiography
12. Risk stratification (assessment of ejection fraction, treadmill test with imaging, electrocardiography, pharmacologic stress imaging [nuclear or echocardiographic])

Acute Adjunctive Medications

1. Antiplatelets, such as aspirin (ASA) and clopidogrel (Plavix®)
2. Beta blockers, such as metoprolol (Lopressor®), acebutolol hydrochloride (Sectral®), atenolol (Tenormin®), pindolol (Visken®), bisoprolol fumarate (Zebeta®), betaxolol hydrochloride (Kerlone®), carteolol hydrochloride (Cartrol®), carvedilol (Coreg®), esmolol hydrochloride (Brevibloc®), labetalol hydrochloride (Normodyne®, Trandate®), metoprolol succinate (Toprol XL®), nadolol (Corgard®), penbutolol sulfate (Levatol®), propranolol hydrochloride (Inderal®, Betachron ER®), sotalol hydrochloride (Betapace®), timolol maleate (Blocadren®)
3. Nitrates
4. Unfractionated heparin(UFH) or low-molecular-weight heparin (LWMH)
5. Oral anti-arrhythmics (amiodarone, lidocaine)

   Note: Prophylactic use of lidocaine has been shown to be harmful and should be avoided. Lidocaine may be useful in treating arrhythmias associated with significant myocardial infarction and reperfusion (thrombolysis). No other antiarryhthmics are indicated for treatment of acute myocardial infarction.

6. Magnesium
7. Calcium channel blockers, such as diltiazem (Cardizem®, Cartia XT®, Tiazac®, Dilacor XR®), verapamil (Calan®, Isoptin SR®, Verelan®, Covera-HS®), amlodipine (Norvasc®), bepridil (Vascor®), felodipine (Plendil®), isradipine (DynaCirc®), nicardipine (Cardene®), nifedipine (Adalat®, Procardia®, Nifedical®), nisoldipine (Sular®)
8. Glycoprotein IIb-IIIa platelet inhibitors, such as abciximab (ReoPro®), eptifibatide (Integrilin®), tirofiban (Aggrastat®)

Chronic Adjunctive Medications

1. Antiplatelets
2. Beta-blockers
3. Angiotensin-converting enzyme (ACE) inhibitors, such as fosinopril sodium (Monopril®), lisinopril (Prinivil®, Zestril®), captopril (Capoten®), enalapril maleate (Vasotec®), benazepril hydrochloride (Lotensin®), moexipril hydrochloride (Univasc®), perindopril erbumine (Aceon®), quinapril hydrochloride (Accupril®), ramipril (Altace®), trandolapril (Mavik®)
4. Calcium channel blockers
5. Oral nitrates
6. Low-molecular-weight heparin
7. Warfarin (Coumadin®)
8. Oral antiarrhythmics
9. Statins, such as atorvastatin calcium (Lipitor®), fluvastatin sodium (Lescol®), lovastatin (Mevacor®), pravastatin sodium (Pravachol®), simvastatin (Zocor®)
10. Tobacco cessation, such as bupropion and/or nicotine patch

11. Glycoprotein IIb/IIIa platelet inhibitors

Invasive Measures

1. Cardiac catheterization
2. Coronary angiography (emergency, if necessary)
3. Primary percutaneous coronary intervention (PCI) such as percutaneous transluminal coronary angioplasty (PTCA)
4. Coronary artery bypass graft (CABG)

Secondary Prevention/Cardiac Rehabilitation

1. Risk factor counseling, risk factor modification (e.g., smoking cessation, diet, exercise, lifestyle modification, control of hypertension and targeting low-density lipoprotein-cholesterol)
2. Phase I, inpatient, cardiac care unit
3. Phase II, outpatient monitored
4. Phase III, outpatient, non-monitored
5. Phase IV, outpatient cardiac rehabilitation maintenance of functional capacity

Diagnosis of Acute Myocardial Infarction Complications

1. 2-D echocardiography
2. Electrocardiography
3. Doppler color flow imaging

Treatment of Acute Myocardial Infarction Complications

1. Atropine sulfate
2. Transcutaneous cardiac pacing
3. Dopamine hydrochloride (Intropin®)
4. Epinephrine (adrenaline chloride, Epipen®, Sus-Phrine®)
5. Isoproterenol hydrochloride (Isuprel®)
6. Temporary or permanent pacemaker
7. Cardioversion
8. Beta-blockers
9. Type I anti-arrhythmics, such as intravenous amiodarone
10. Digoxin
11. Adenosine (Adenocard®)
12. Diuretics
13. Vasodilators
14. Oral or intravenous diltiazem
15. Long-acting nitrates
16. Calcium channel blockers
17. Anti-inflammatory agents
18. Intravascular volume expansion
19. Swan-Ganz catheter insertion
20. Intraaortic balloon pump insertion (IABP)
21. Surgical repair of heart ruptures
22. Early coronary angiography
23. Pericardiocentesis, preferably guided by echocardiography

MAJOR OUTCOMES CONSIDERED

- Morbidity and mortality from acute myocardial infarction
- Incidence of nonfatal recurrent myocardial infarction

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METHODOLOGY

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METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

Not stated

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Expert Consensus (Committee)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not applicable

METHODS USED TO ANALYZE THE EVIDENCE

Review of Published Meta-Analyses
Systematic Review

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Not stated

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

The guideline developers reviewed published cost analyses. One analysis pertained to risk stratification and management after myocardial infarction. A second analysis pertained to early discharge in low-risk patients.

METHOD OF GUIDELINE VALIDATION

Clinical Validation-Pilot Testing
Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Institute Partners: System-Wide Review

The guideline annotation, discussion and measurement specification documents undergo thorough review. Written comments are solicited from clinical, measurement, and management experts from within the member groups during an eight-week review period.

Each of the Institute's participating member groups determines its own process for distributing the guideline and obtaining feedback. Clinicians are asked to suggest modifications based on their understanding of the clinical literature coupled with their clinical expertise. Representatives from all departments involved in implementation and measurement review the guideline to determine its operational impact. Measurement specifications for selected measures are developed by the Institute for Clinical Systems Improvement (ICSI) in collaboration with participating member groups following implementation of the guideline. The specifications suggest approaches to operationalizing the measure.

Guideline Work Group

Following the completion of the review period, the guideline work group meets 1 to 2 times to review the input received. The original guideline is revised as necessary and a written response is prepared to address each of the responses received from member groups. Two members of the Cardiovascular Steering Committee carefully review the input, the work group responses, and the revised draft of the guideline. They report to the entire committee their assessment of four questions: (1) Is there consensus among all ICSI member groups and hospitals on the content of the guideline document? (2) Has the drafting work group answered all criticisms reasonably from the member groups? (3) Within the knowledge of the appointed reviewer, is the evidence cited in the document current and not out-of-date? (4) Is the document sufficiently similar to the prior edition that a more thorough review (critical review) is not needed by the member group? The committee then either approves the guideline for release as submitted or negotiates changes with the work group representative present at the meeting.

Pilot Test

Member groups may introduce the guideline at pilot sites, providing training to the clinical staff and incorporating it into the organization's scheduling, computer and other practice systems. Evaluation and assessment occurs throughout the pilot test phase, which usually lasts for three to six months. At the end of the pilot test

phase, ICSI staff and the leader of the work group conduct an interview with the member groups participating in the pilot test phase to review their experience and gather comments, suggestions, and implementation tools.

The guideline work group meets to review the pilot sites' experiences and makes the necessary revisions to the guideline, the Cardiovascular Steering Committee reviews the revised guideline and approves it for release.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

The recommendations for the treatment of acute myocardial infarction are presented in the form of two algorithms with a total of 41 components, accompanied by detailed annotations. Algorithms are provided for: Treatment of Acute Myocardial Infarction (AMI) and Acute Myocardial Infarction Complications; clinical highlights and selected annotations (numbered to correspond with the algorithms) follow.

Class of evidence (A-D, M, R, X) ratings are defined at the end of the "Major Recommendations" field.

Clinical Highlights for Individual Clinicians

1. Thrombolysis should be instituted within 30 to 60 minutes of arrival. (Annotation #9)
2. Angiogram/primary percutaneous coronary intervention (PCI) should be performed within 90 minutes of arrival with a target of less than 60 minutes. (Annotation #10)
3. Use of medication: aspirin (ASA) or 81 mg ASA and clopidogrel (Plavix®) at admission, beta-blockers whenever possible and/or angiotensin-converting enzyme (ACE) inhibitors at 24 hours if stable, and statins at discharge. (Annotations #14 and 32)
4. Recommend addressing tobacco cessation in patients who have used tobacco products within the past year, dietary instruction including a heart healthy diet, and manageable exercise within 24 hours of admission. Risk factor modification should be thoroughly explained to patients and documented in the medical record. (Annotations #14, 27 and 28)
5. Recommend appropriate use of cardiac rehabilitation post-discharge. (Annotations #30 and 31)

Treatment of Acute Myocardial Infarction (AMI) Algorithm Annotations

1. Acute Myocardial Infarction (AMI)

   Patient presents with classic angina of at least 30 minutes' duration, plus any of the following:

   - ST-segment elevation in two or more contiguous leads ($\geq$1 mm in limb leads or $\geq$2 mm in precordial leads) or new or presumably new left

bundle branch block (LBBB) or ST-segment depression ≥ 2 mm in V_1V_2 (true posterior infarction)

- T-wave inversion or ST-segment depression in any lead persisting for >24 hours that is unrelieved by nitroglycerin

It is difficult to make the diagnosis of AMI in patients without ST-segment elevation, but this treatment guideline should be considered in such patients until the diagnosis is ruled out. See Annotation Appendix A of the original guideline document, "Acute Coronary Syndromes (ACS)/Unstable Angina" for information on signs, symptoms of ACS secondary to coronary artery disease (CAD) and unstable angina.

2. Emergency Management and Acute Adjunctive Medications
   A. Emergency Management

   A chest pain protocol should be in place to ensure the following occur within 30 minutes of presentation:

   1. Obtain 12 lead electrocardiogram (ECG).
   2. Begin cardiac monitoring.
   3. Administer supplemental oxygen.
   4. Establish intravenous (IV) access at two or three sites (especially if thrombolytics are to be administered). Rapid volume expansion with normal saline solution may be indicated.
   5. Routine laboratory studies:
      - Electrolytes, blood urea nitrogen (BUN), creatinine, complete blood count and marker(s) for myocardial injury (creatine kinase [CK]/creatine kinase isoenzyme-myocardial [CK-MB] or troponin).
      - Normal serial CK values rule out acute infarction, but not unstable angina. A slight rise in CK-MB or troponin indicates myocardial injury, but is not specific for ischemic syndromes.
      - Troponin assay is highly sensitive for identifying acute coronary syndromes (ACS). Though more sensitive than CK/CK-MB, (due to its longer biologic half-life in serum) it is less specific for identifying infarction versus repeated episodes of ischemia. As the total CK greater than 2 times above normal upper limit has been identified previously as indicative of infarction, total CK remains a useful adjunctive test in assessing infarction versus ischemia and non-invasively determining effectiveness of reperfusion. The more sensitive troponin assay will more often be positive for other causes of myocardial injury such as myocarditis, myocardial contusion, and microvascular injury in shock. Thus, the interpretation of an abnormal serum troponin (or CK-MB) is dependent upon the clinical setting in which the myocardial injury occurred.
      - A serum Troponin assay may require up to six hours to become diagnostically sensitive. Serum myoglobin is a more sensitive marker that may indicate muscle injury

within four hours. A positive serum myoglobin in the absence of skeletal muscle injury provides an early indication of AMI.

6. Administer IV or sublingual nitrates to lower blood pressure if needed and potentially relieve pain.

7. Administer analgesics and/or anxiolytics: morphine sulfate, 2 to 5 mg IV every 5 to 10 minutes as needed. Benzodiazepines may be of benefit in selected patients.

8. Check vital signs often. An automatic recording blood pressure cuff is helpful.

9. Administer thrombolytics within 30-60 minutes or perform primary PCI within 60-90 minutes. (see Treatment Algorithm Annotations #9 titled "Thrombolytics" and #10 titled "Emergency Angiography and Primary PCI" below).

B. Acute Adjunctive Medications

Immediate use of the following adjunctive medications should be considered. Use of any of these should be reconsidered throughout the patient's hospitalization and at discharge.

- Antiplatelets,*81, 160, 325 mg aspirin (ASA) or 300 mg clopidogrel (Plavix®) and 81 mg ASA, given as soon as possible. The first dose should be chewed. Acute ASA should be withheld only from patients with true anaphylactic allergy. Aspirin-sensitive patients may be switched to the enteric-coated form after the initial dose.

  Many institutions prefer to avoid early clopidogrel in primary PCI and medical therapy of patients with AMI, as well as non-ST-segment elevation myocardial infarction (STEMI)/unstable angina acute coronary syndrome (ACS) patients, until it is clear there is no indication for surgical revascularization. Up-front glycoprotein IIb-IIIa inhibitor use is clinically indicated in this setting and avoids clopidogrel's prolonged platelet inhibition in patients who may demonstrate a surgical indication. Patients who are ASA sensitive may be switched to the enteric-coated form after the initial dose. The 2002 update for the American College of Cardiology (ACC)/American Heart Association (AHA) guideline on unstable angina (UA)/non-ST segment elevation myocardial infarction (Non-STEMI) directs treatment with clopidogrel should be started on admission unless a surgical indication is suspect.

  If clopidogrel is given and coronary artery bypass surgery planned, clopidogrel should be held for 5 days prior to surgery due to increased risk of perioperative bleeding.

  Clopidogrel is also indicated for patients with ACS and overt infarction who do not receive stents and may provide greater benefit with prolonged use of up to a year. Selected patients at high risk for recurrent bleeding on chronic ASA due to history of non-steroidal anti-inflammatory drug (NSAID) gastropathy may

be more safely managed after the acute phase with indefinite clopidogrel therapy alone.

- Beta-blockers,* such as metoprolol (Lopressor®), 5 mg IV every 5 minutes for three doses, followed by 25 to 50 mg orally every 6 hours for 48 hours, then 50 to 100 mg orally twice a day. Relative contraindications include systolic blood pressure <100 mm Hg, heart rate <60 beats/min, reactive airway disease, and heart block greater than first degree.

  Beta-blockers should be used with caution in overt asthmatics, in combination with non-dihydropyridine calcium channel blockers due to the risk of adverse effects. Beta-blockers have been recognized as underused in AMI patients with peripheral vascular disease, chronic lung disease (COPD), and diabetes mellitus (DM) in both the National Registry of Myocardial Infarction (NRMI) and the Cooperative Cardiovascular Project (CCP). In addition to proven benefit in mild to moderate heart failure, the cautious use of beta blockers in patients with left ventricular (LV) dysfunction including class III and class IV congestive heart failure (CHF) is well supported by clinical trial data (COPERNICUS and for AMI, CAPRICORN) A short-acting beta-blocker such as IV esmolol may be considered if the clinician is concerned about potential adverse effects of beta-blockers.

  * Shown in large clinical trials to reduce infarction mortality. Please refer to the "Discussion" section in the original guideline document.

  Evidence supporting this recommendation is of classes: A, B, R

- Nitrates. A mortality benefit has not been clearly demonstrated for acute nitrate therapy, but the sublingual and intravenous forms may help reduce infarction symptoms and be useful in acute treatment of CHF and hypertension. The dose should be adjusted to relieve symptoms and maintain systolic blood pressure at >90 mm Hg. Hypotension and/or bradycardia may occur more often with nitrate use in patients with inferior myocardial infarction. Establishment of at least one IV site should be considered prior to nitroglycerin use in case hypotension should occur.

  Evidence supporting this conclusion is of class: A

- Unfractionated heparin (UFH) or low-molecular-weight heparin (LMWH). UFH or LMWH is indicated in all STEMI and non-STEMI infarcts except when streptokinase is used. Use of heparin is required with use of tissue-type plasminogen activator (tPA) reteplase (r-Pa) and tenecteplase (TNK).

UFH is commonly used during conversion to warfarin sodium (Coumadin®) in patients with anterior MI, especially when LV function is severely reduced or extensive apical thrombus is present. Bleeding incidence increases when heparin is used with IIb/IIIa platelet inhibitors, such as abciximab (ReoPro®), given in standard doses. Adjustment of UFH or LMWH dosage is recommended when a IIb-IIIa inhibitor is used.

Low-molecular-weight heparin has been shown to be effective and superior to unfractionated heparin in patients with no ST-segment elevation and should be used preferentially in that setting. (See Treatment Algorithm Annotation #13 titled "Coronary Care Unit Admission" below).

Evidence supporting this recommendation is of class: A

- Antiarrythmics: Amiodarone and Lidocaine. Amiodarone is the current drug of choice for the management of ventricular tachycardia (VT) and ventricular fibrillation (VF) according to Advanced Cardiac Life Support (ACLS) Guidelines.

  Prophylactic use of lidocaine has been shown to be harmful and should be avoided. The drug may be useful in treating arrhythmias associated with significant MI and reperfusion (thrombolysis). No other antiarrythmics are indicated for treatment of AMI.

  Evidence supporting this recommendation is of class: M, R

- Magnesium, 1 g by slow IV push, then 15 g over 24 hours. The drug should be used with caution in patients with reduced renal function, hypotension, or greater than first-degree heart block, but it may be of benefit in patients with higher-risk AMI, especially if reperfusion therapy is not given.

  Evidence supporting this recommendation is of classes: A, R

- Calcium channel blockers. These drugs are contraindicated for patients with reduced ejection fraction or CHF. They may be used in patients with contraindications to beta blockers for control of postinfarction angina or hypertension. They may compound the toxicity of beta blockers or digoxin (Lanoxicaps®, Lanoxin®) and should be used cautiously in conjunction with these agents. Short-acting dihydropyridine calcium channel blockers (e.g., nifedipine) may be associated with increased risk and should be avoided in acute ischemic syndromes.

  Evidence supporting this recommendation is of class: A

- Glycoprotein IIb-IIIa platelet inhibitors. Maximal medication therapies including aspirin, intravenous/oral beta-blocker, heparin and nitrates should be aggressively employed in acute coronary syndrome (ACS) patients with refractory unstable angina, usually with evidence of ischemia by ST depression or positive troponin. Consider the use of IIb-IIIa inhibitors in the following settings:
  - Evidence of acute ischemia with failure to respond to aggressive medical therapy within 30 minutes.
  - ST elevation infarction (STEMI) or other ACS patient going to emergent diagnostic angiography and possible acute percutaneous coronary intervention (PCI).
  - Non-ST elevation infarction (Non-STEMI)/ACS patients as a stabilization strategy prior to elective angiography and possible PCI or as an adjunctive treatment in addition to aggressive medical therapy in patients in whom an intervention poses greater risk and/or reduced likelihood of success.

  Relative contraindications to the use of glycoprotein IIb-IIIa receptor inhibition are similar to the contraindications for thrombolytics (see Treatment Algorithm Annotation #9 titled "Thrombolytics," below). Increased international normalized ratio (INR) and thrombocytopenia are specific relative contraindications. Agents are contraindicated or require dose adjustment for renal dysfunction. Duration of effect on discontinuation may be prolonged.

  In patients with non-STEMI, anticoagulation with subcutaneous LMWH or IV UFH should be added to antiplatelet therapy with ASA and/or clopidogrel. Although the data are not definitive, it does appear that glycoprotein IIb-IIIa inhibitors can be used with LMWH. Use of glycoprotein IIb-IIIa inhibitors with fractionated heparin such as Lovenox® is investigational. Limited data suggest 60% to 75% of the standard fractionated heparin dose is appropriate.

  Currently available studies have failed to indicate superiority of combined glycoprotein IIb-IIIa inhibitors in combination with various plasminogen activators for the primary endpoint-- mortality. Institutions relying on thrombolysis should continue to use one of the established regimens.

  Evidence supporting this recommendation is of classes: A, R

3. Medication tables and dosing protocols can be found in Annotation Appendices B and C of the original guideline document.
4. Special Considerations for Patients with Diabetes: Use of Insulin
5. Patients with diabetes, including patients with previously untreated or oral medication-treated diabetes, have reduced one-year mortality when treated aggressively with insulin. The goal is to achieve normoglycemia. Insulin

infusion should be started as soon as possible after admission and continued for at least 24 hours with subsequent conversion to three times daily subcutaneous insulin.

6. ST-Segment Elevation on ECG?

About 50% of patients with AMI present with ST-segment elevation. They can be treated with thrombolytics or with emergency coronary angiography and angioplasty. Patients presenting with chest pain but no ST-segment elevation may be triaged to the telemetry unit if they are hemodynamically stable and pain-free. Troponin levels that are abnormally elevated for the assay being used may represent infarction.

5. Ongoing Chest Pain Present?

If chest pain present for more than 30 minutes is unrelieved by medications, emergency coronary angiography and primary PCI may be considered. If the patient has received thrombolytics, pain may not resolve for 60 to 90 minutes. If the patient experiences persistent pain after administration of thrombolytics, the clinician should decide if the patient should be referred for rescue PCI.

6. Consider Echocardiography if Available and Emergency Coronary Angiography

Patients without ST-segment elevation may require further diagnostic procedures, such as echocardiography, to rule out complications prior to consideration of emergency coronary angiography. Patients without significant ST-segment elevation who are hemodynamically unstable with or without ongoing chest pain may be considered for emergency coronary angiography and PCI if appropriate (i.e., no evidence of acute valvular dysfunction, which may necessitate emergency echocardiography).

7. Needs Coronary Care Unit (CCU) Admission?

Triage to the coronary care unit (CCU) or intensive care unit (ICU) should be considered for patients presenting to the Emergency Department (ED) with ST-segment shift and ongoing chest pain or with hemodynamic instability.

8. Admit to Telemetry Unit

Patients without acute ST-segment elevation or considered to have low-risk myocardial infarction may be admitted to a non-intensive care unit bed (see Treatment Algorithm Annotation #2 titled "Emergency Management and Acute Adjunctive Medications," in the original guideline document).

9. Thrombolytics

Indications for thrombolysis include the following:

- ST-segment elevation in two or more contiguous leads ($\geq$1 mm in limb leads or $\geq$2 mm in precordial leads) or new left bundle branch block

(LBBB) or ST-segment depression $\geq$2 mm in V_1V_2 (true posterior infarction), plus

- Angina lasting 30 minutes to 12 hours that is unrelieved by nitroglycerin.

Thrombolytics Contraindications*

Absolute Contraindications

- Previous hemorrhagic stroke at any time: other strokes or cerebrovascular events within one year
- Known intracranial neoplasm
- Active internal bleeding (does not include menses)
- Suspected aortic dissection

Cautions/Relative Contraindications

- Severe uncontrolled hypertension on presentation (blood pressure >180/110 mm Hg)**
- History of prior cerebrovascular accident or known intracerebral pathology not covered in contraindications
- Current use of anticoagulants in therapeutic doses (International Normalized Ratio $\geq$2.0 to 3.0); known bleeding diathesis
- Recent trauma (within 2 to 4 weeks), including head trauma
- Noncompressible vascular punctures
- Recent internal bleeding
- For streptokinase/anistreplase: prior exposure (especially within 5 days to 2 years) or prior allergic reaction
- Pregnancy
- Active peptic ulcer
- History of chronic hypertension

Adapted from the "American College of Cardiology (ACC)/American Heart Association (AHA) Pocket Guidelines: The Management of Patients with Acute Myocardial Infarction. A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines" (Bethesda [MD]: American College of Cardiology, 2000 Apr. 36 p.) (Class R)

*Advisory only. May not be all-inclusive or definitive.

**Severe uncontrolled hypertension on presentation (blood pressure >180/110 mm Hg) is a relative contraindication to thrombolysis. Even if hypertension on presentation is brought under control, patients subsequently treated with thrombolytics experience increased intracranial hemorrhage (ICH) compared to patients who are normotensive on presentation. Consider local primary PCI or transfer for primary PCI in these high-risk hypertensive patients if feasible.

Patients with relative contraindications are evaluated on an individual basis. Primary angioplasty may provide equal or increased benefit at decreased risk. Prior use of streptokinase is a relative contraindication to repeated use.

Cardiopulmonary resuscitation performed for less than 10 minutes is not a contraindication.

Administration of Lytics

Usually, the emergency department physician makes the decision to treat, without the delay caused by consultation. The goal is to initiate thrombolytic therapy within 30 to 60 minutes of the patient's arrival in the emergency department.

Low patient weight has been identified as an ongoing risk factor for significant intracranial hemorrhage when thrombolytics are administered. It is imperative to accurately estimate the weight of patients with acute myocardial infarction to determine the proper dose of thrombolytic to minimize the risk of intracranial hemorrhage.

Single-bolus agents, such as tenecteplase (TNKase®) simplify administration, however patient weight remains important in calculating dose.

Use of tPA over streptokinase may have a mortality benefit in patients with large myocardial infarction or complicated inferior myocardial infarction (associated with high degree of atrioventricular [AV] block, pulmonary congestion, hypertension, or symptomatic ventricular ectopy) and in those who have had coronary artery bypass grafting (CABG), who usually have a large thrombus burden in the bypass graft. No such mortality benefit is present in patients who have nonanterior myocardial infarction (i.e., inferior myocardial infarction) that is uncomplicated.

Streptokinase, rather then tPA, should be considered for patients over age 75, who have a significantly increased intracranial hemorrhage rate, and patients who present with cardiogenic shock, who have a high mortality rate with either drug. Use of reteplase (Retavase®) results in a higher incidence of normal flow rates than use of tPA but yields no clinical advantages in mortality rate.

Thrombolytic protocols can be found in Annotation Appendix D of the original guideline document.

10. Emergency Coronary Angiography and Primary PCI

Primary PCI has been demonstrated to be more effective than thrombolysis in opening acutely occluded arteries in settings where it can be rapidly employed by experienced interventional cardiologists.

Time to open artery is critical to effective primary PCI. Current American College of Cardiology/American Heart Association guidelines suggest that institutions wishing to apply primary PCI for STEMI should achieve a median door to balloon time of 90 minutes or less. The AHA/ACC Consensus Panels have set a 60-minute median door to balloon time as the benchmark for top performing institutions.

Institutions that cannot meet the recommended treatment times should consider preferential use of intravenous thrombolytic therapy. These institutions should have a predetermined plan for treating patients who present with contraindication to thrombolytics.

Aspirin, heparin, beta-blockers, and possibly glycoprotein IIb-IIIa inhibitors should be administered early to these patients, unless contraindicated.

Primary PCI may also play a role in the treatment of non-STEMI/refractory angina pectoris if angina symptoms fail to resolve within an hour of instituting aggressive anti anginal therapy with aspirin, heparin, beta-blockers, and glycoprotein IIb-IIIa inhibitors; or serial EKG or echocardiogram suggest a large amount of myocardium at risk.

11. Percutaneous Coronary Intervention (PCI) or Coronary Artery Bypass Graft (CABG)?

In high-risk patients with ACS/non-STEMI, pretreatment with a glycoprotein IIb-IIIa inhibitor and early invasive evaluation with mechanical revascularization (PCI or CAB) has been shown to improve outcomes.

Rescue angioplasty involves the use of PCI to restore coronary flow after thrombolysis has failed. Guidelines for time from arrival to balloon inflation are not established for this complex subset of patients, but rescue PCI should be accomplished within 90-120 minutes of thrombolytic failure if possible. Thrombolytic failure may be evident by failure of ST-elevation to resolve within 30-60 minutes of thrombolytic therapy and usually includes persistent symptoms.

Facilitated PCI is the use of additional agents to pretreat the patient awaiting primary PCI. No strategy employing full- or reduced-dose thrombolytic (with or without a glycoprotein IIb-IIIa receptor inhibitor) has been approved for facilitated PCI.

There is evidence to support the early use (prior to interventional laboratory arrival) of glycoprotein IIb-IIIa inhibitors with heparin and aspirin in patients going directly to the interventional laboratory for primary PCI.

The best use of low-molecular-weight heparins in these patients is not yet established. Investigations currently underway should better address the use of low-molecular-weight heparins in PCI.

Current ACC guidelines recommend treating the culprit vessel when feasible and deferring surgical or PCI-based revascularization of other vessels until the patient has stabilized and the clinically most appropriate strategy determined.

Evidence supporting this recommendation is of classes: A, D, M, R

13. CCU Admission

Patients who present with acute ST-segment elevation, hemodynamic instability, or both should be admitted to the CCU. Early use of adjunctive medications can be reconsidered. (see Treatment Algorithm Annotation #2 titled "Emergency Management and Acute Adjunctive Medication"). A CCU admission order set template has been developed by the Institute for Clinical Systems Improvement (ICSI) Acute MI work group and is available from ICSI--see the Support for Implementation section in the original guideline document.

14. CCU Care: Chronic Adjunctive Medications/Phase I Cardiac Rehabilitation

A protocol should be in place to guide routine orders for continuous monitoring, oxygen delivery, IV therapy, activity, laboratory and diagnostic tests, diet, and medications.

Use of the following medications should be considered:

- ASA* should be continued as the clinical situation warrants. ASA has been shown to reduce reinfarction and mortality long-term, and should be continued whenever possible.
- Clopidogrel. ASA (81 mg) with clopidogrel in intermediate high-risk ACS patients is beneficial. Anyone with an allergy to aspirin or nonsteroidal antiinflammatory drugs should receive a bolus dose of clopidogrel with maintenance dosing indefinitely. ASA plus clopidogrel or clopidogrel alone can also be used with patients who have stents. If clopidogrel is given and coronary artery bypass surgery is planned, clopidogrel should be held for 5 days prior to surgery due to increased risk of perioperative bleeding.
- Beta-blockers. Beta-blockers reduce mortality, readmission and reinfarction for both CAD and CHF. They should be instituted and/or continued whenever possible. Intravenous esmolol should be considered if a clinician is concerned about potential adverse effects of beta-blockers. Patients who prove intolerant in the hospital after a large infarct should be considered for beta-blocker treatment after discharge.
- Angiotensin-converting enzyme (ACE) inhibitors. ACE inhibitors are indicated (in addition to beta-blockers, when possible) for most patients following AMI to reduce mortality and morbidity associated with large infarcts with significant LV dysfunction, reduce adverse ventricular remodeling which may result in further education in ejection fraction, and for potential reduction of future MI and stroke.

  *Shown in large clinical trials to reduce infarction mortality.

  Evidence supporting these recommendations is of class: A

- Calcium channel blockers may be useful for control of blood pressure and ischemic pain when beta blockers are contraindicated but should be avoided in patients with decreased left ventricular function or heart failure. The short-acting dihydropyridine calcium channel

blockers (e.g., nifedipine) may be associated with increased risk and should be avoided in acute ischemic syndromes.

- Oral nitrates may benefit selected patients with postinfarction angina or CHF.
- Low-molecular-weight heparin has been shown to be superior to unfractionated heparin in patients without ST-segment elevation and can preferentially be used in subcutaneous dosing (e.g., enoxaparin sodium [Lovenox®], 1 mg/kg every 12 hours). Heparin may be continued for 2 to 4 days or maintained until conversion to warfarin is completed. If unfractionated heparin is used, the dose should be regulated to maintain an activated partial thromboplastin time of 50 to 75 seconds (see Treatment Algorithm Annotation #2 titled "Emergency Management and Acute Adjunctive Medications").
- Warfarin therapy may be initiated in certain clinical situations (e.g., postinfarction congestive heart failure or anterior myocardial infarction with high risk of left ventricular thrombus) as soon as clinical stability is achieved and invasive diagnostic studies are completed. The usual target international normalized ratio is 2.0 to 3.0.
- Oral antiarrhythmics are not recommended, especially when LV function is reduced. Flecainide acetate (Tambocor®) and sotalol hydrochloride (Betapace®) should be avoided in patients with significant structural heart disease unless clearly indicated on the basis of electrophysiologic study for the suppression of life-threatening ventricular arrhythmias. Beta-blockers are the current drug of choice when tolerated. Routine use of amiodarone hydrochloride (Cordarone®) in post-myocardial infarction patients with nonsustained ventricular ectopy has not been shown to reduce mortality.

  Evidence supporting this conclusion is of classes: A, M

- Statins. The large majority of patients who have an acute myocardial infarction have high serum lipid levels. Lipid treatment, including administration of statins, should be addressed as soon as possible. A patient's lipid status should be determined within the first 24 hours. If the low-density lipoprotein (LDL) level is $\geq$100 mg/dl, the patient should be started on a statin.
- Tobacco cessation should be addressed as soon as possible for patients who smoke or use tobacco products. Appropriate treatment may include administration of bupropion and/or a nicotine patch in the hospital.

Medication tables and dosing protocols are attached in Annotation Appendices B and C of the original guideline document.

Phase 1 Cardiac Rehabilitation

With shortened length of stay, teachable moments may be limited. As a result, timely initiation of education on lifestyle modification is crucial. Phase 1 cardiac rehabilitation should begin as soon as the patient is stable and pain-free. Goals are to minimize harmful effects of immobilization, assess the hemodynamic response to exercise, manage the psychosocial issues of

cardiac disease, and educate the patient and family about lifestyle modification including:

- Tobacco cessation
- Dietary instruction including a heart healthy diet
- Manageable exercise regimen should be explained

15. Complications?

Arrhythmic complications include sinus bradycardia, Möbitz I block (Wenkebach), Möbitz II block, complete heart block or asystole, premature ventricular contractions (PVCs), ventricular tachycardia, ventricular fibrillation, accelerated idioventricular rhythm, and supraventricular arrhythmias (atrial flutter, atrial fibrillation, and supraventricular tachycardia). Ischemic complications include postinfarction angina. Mechanical complications include papillary muscle dysfunction, rupture with significant mitral regurgitation, ventricular septal rupture, myocardial rupture, right ventricular infarction, pericarditis with or without tamponade, left ventricular dysfunction, and aneurysm formation.

17. Transfer to Post-CCU Care

Patients should be transferred from the CCU to the telemetry or step-down unit when they are pain-free, hemodynamically stable, and meet the institution's protocol for admission to the telemetry unit (usually 12 to 24 hours after MI). Discontinuation of cardiac monitoring should be considered for patients who attain electrical stability (usually within 3 days of infarction).

20. Risk Stratification

Assessment of ejection fraction is important in predicting prognosis. Most patients should undergo echocardiography or other assessment of LV ejection fraction. A treadmill test is useful for assessing functional reserve but is not useful for predicting recurrence of AMI. If ST-segment depression or angina is present early in treatment, angiography should be considered. If the patient is unable to exercise or the electrocardiogram is uninterpretable, pharmacologic stress imaging (nuclear or echocardiographic) should be considered.

21. Patient at Increased Risk and Needs Intervention?

Patients who are at increased risk for adverse prognosis after AMI and who are also candidates for short-term intervention include those with a large amount of myocardial necrosis (ejection fraction <40%), residual ischemia (angina during hospitalization or exercise testing), electrical instability (>10 premature ventricular contractions/hour), left main or three-vessel CAD, limited exercise tolerance, or rales in more than one-third of lung fields.

The following factors increase long-term risk: age $\geq$70, previous infarction, anterior-wall MI, hypotension and sinus tachycardia, diabetes, female sex, continued smoking, atrial fibrillation, and CHF.

22. Cardiac Catheterization

Angiography should be performed in patients at increased risk as defined in Treatment Algorithm Annotation #21 titled "Patient at Increased Risk and Needs Intervention?".

Recent trials (collectively FRISC II and TACTICS-TIMI 18) suggest an early aggressive/invasive approach (early diagnostic coronary angiography and appropriate PCI or CABG) within 48 hours of presentation, in non-STE ACS (with ST segment deviation, elevated cardiac markers or TIMI Risk Score greater than 3), significantly reduces the risk of major cardiac events. A TIMI Risk Score Calculator can be downloaded at www.timi.org/files/riskscore/risk_home.htm.

23. Revascularization Candidate?

CABG should be considered in patients with left main, three-vessel, or two-vessel disease with left anterior descending coronary artery involvement and demonstration of ischemia. Pharmacologic or stress test imaging may be helpful if myocardial viability is uncertain and revascularization is considered.

PCI should be considered in patients with acceptable anatomy in whom its prognostic effect has been most clearly demonstrated: significant residual ischemia, CABG candidacy, and failure of maximal medical therapy (two of three medications) to control angina or contraindications to medications.

26. Continue Adjunctive Medications

See Treatment Algorithm Annotation #14 titled "Coronary Care Unit Care: Chronic Adjunctive Medications/Phase I Cardiac Rehabilitation".

27. Secondary Prevention and Risk Factor Modification

Modification of risk factors (e.g., high lipid levels, hypertension, smoking) significantly reduces subsequent cardiovascular mortality. Risk factor counseling must be documented in the medical record in a consistent manner. A "care plan" or "critical pathway" approach with flow sheets may be used. Ongoing patient monitoring and feedback are important. Adjunctive therapy (ASA or ASA and clopidogrel, beta-blockers, warfarin for large anterior infarctions, ACE inhibitors) should be continued.

Evidence supporting this recommendation is of class: A, D, M, R

28. Discharge

Complete and document the following before discharge:

- Patient education that includes discharge diagnosis, medical regimen, lifestyle modification issues, and functional limitation (including resumption of sexual activity and driving)
- Scheduling of a follow-up appointment with the primary care physician

- Targeting a return-to-work date. Patients with sedentary jobs often return to work in 2 to 3 weeks. More physically demanding jobs often can be resumed in 4 to 6 weeks unless significant ischemia is present.

Patients are commonly discharged in less than 3 days following successful primary PCI with evidence of complete or near complete salvage of threatened myocardium. Though patients should avoid strenuous exertion for several weeks during the stent healing phase, many such patients may return to sedentary or only moderately active work activities within days of discharge.

Information on discharge medication can be found in Annotation Appendix E of the original guideline document.

Evidence supporting this conclusion is of class: A

29. ECG-Monitored Exercise Needed?

Most patients do not require an ECG-monitored, hospital-based (phase 2; outpatient) exercise program, but those with any of the following characteristics may be at increased risk for infarction or sudden death with unmonitored exercise and should be considered for a phase 2 program, usually lasting 1 to 4 weeks: very low functional capacity (less than 4 METs), severely depressed ventricular function (ejection fraction $\leq$35%), complex resting ventricular arrhythmias, exercise-induced hypotension, exertional angina or significant silent ischemia, or inability to initiate a self-directed exercise program.

For certain patients, referral to a phase 2 program may facilitate earlier hospital discharge by providing emotional support in the outpatient hospital setting. The decision to refer a patient to a phase 2 program should be made on a case-by-case basis. The patient's current exercise capacity and the demands of expected occupational and recreational activities should be considered.

30. Phase 2 Cardiac Rehabilitation/Outpatient Management

Phase 2 (outpatient monitored) programs, if indicated, consist of medically supervised exercise with continuous electrocardiogram monitoring attended by trained personnel who have emergency equipment. Most phase 2 programs are hospital-based. Health education and risk factor modifications need to be included in these programs.

Average progression is an increase of 1 MET every 2 weeks. Discharge should be considered after exercise of 5 METs is attained. The patient should be familiar with his or her rate or perceived exertion. Some patients may require as little as 1 week of monitored exercise.

A table of METs can be found in Annotation Appendix F of the original guideline document.

Note: A MET is a multiple of the resting energy expenditure; 1 MET = approximately 3.5 cc oxygen consumed/kg/min.

31. Phase 3 Cardiac Rehabilitation/Outpatient Management

Phase 3 programs are outpatient non-monitored. At hospital discharge, patients should receive an exercise prescription based on tolerance to in-hospital activity, risk factors, and stress testing (if done). Some patients may benefit from participation in support groups. Health education and lifestyle modification begun in the hospital should be continued. Up to 10% of patients with myocardial infarction have significant depression; counseling and stress reduction may be helpful, but if symptoms persist for more than 4 weeks, referral to a psychiatric specialist may be needed. Tricyclic antidepressants are best avoided.

Phase 3 cardiac rehabilitation emphasizes exercise training and activity prescription, risk factor modification, and psychosocial evaluation and counseling in an attempt to lower morbidity and mortality following myocardial infarction. The following should be considered when writing an exercise prescription:

- Exercise treatment. Individual modifications are necessary. Also, the need for subjective and objective evaluation in the CAD exercise population is crucial, necessitating close follow-up to optimally fine-tune the patient's prescription and promote adherence. Continued education about the signs and symptoms of overexertion, angina, and cardiopulmonary distress is important.
- Type of Exercise. Aerobic exercise is emphasized. It includes any activity that preferentially uses large muscle groups and can be maintained for a prolonged period (e.g., walking). Pure isometric exercise should be minimized because it may result in LV decompensation in patients with poor LV function.
- Intensity of Exercise. This should be based on an exercise tolerance test or the MET level at discharge from phase 2 rehabilitation. In patients with an angina threshold of 2 to 3 METs, exercise training may not be appropriate.
- Target heart rate. This should be determined from an exercise test or a monitored exercise session. If this is not feasible, target heart rate can be calculated as follows:

    220 - age = maximum heart rate

    65% x maximum heart rate = target heart rate

    This applies to patients who are not taking a beta-blocker and who have been shown to tolerate the heart rate without ischemia.

- Monitoring rate of perceived exertion. The Borg scale of perceived exertion is a useful tool in guiding exercise programs. It is used in conjunction with the target heart rate when instructing patients on exercise tolerance. Target rates are usually between 11 (fairly light) and 14 (somewhat hard to hard).

- Duration of exercise. Initially, multiple 10-minute bouts distributed throughout the day may be optimal for some patients. During the first 2 to 6 weeks of participation, exercise duration should be gradually increased from 30 minutes to 45 minutes or more. (This does not include the warm-up, cool down, or stretching periods crucial to any workout.) Duration should be increased to 20 to 30 minutes before intensity is increased. A steady rate of perceived exertion should be maintained by increasing activity as tolerated.
- Frequency of exercise. From the onset, exercise frequency should be 3 to 5 times per week.

The perceived exertion scale (Borg Scale) is attached in Annotation Appendix G of the original guideline document.

Evidence supporting this recommendation is of classes: A, M, R

32. Short-Term Follow-Up: Chronic Adjunctive Medications/Outpatient Management

Chronic Adjunctive Medications

Use of enteric-coated ASA or ASA plus clopidogrel should be continued. Use of beta-blockers following MI has been shown to reduce ischemia, prevent arrhythmias and reinfarction, and improve survival. Patients with large anterior infarctions may benefit from low-dose warfarin therapy, usually for 3 months. ACE inhibitors provide long-term cardiac protection for patients (with or without symptoms) with LV ejection fraction of less than 40%.

Most patients should be receiving a statin or alternative lipid-lowering medication at discharge from the hospital. Lipid-lowering therapy should be considered for patients who have undergone PCI or CABG and patients whose low-density lipoprotein cholesterol level is 100 mg/dL or greater. Calcium channel blockers should be considered only for patients with non-Q wave myocardial infarction (NQMI) and patients without CHF or decreased left ventricular ejection fraction. Oral nitrates should be considered for patients with ongoing ischemia.

Follow-Up Visits

Usually, patients should return for a follow-up visit with their cardiologist or primary care physician within 2 to 3 weeks so the physician can monitor progress, answer questions, and consider further risk stratification (i.e., stress testing). Risk factor modification should be continued.

Follow-up visits also provide an opportunity to assess patient adherence with chronic adjunctive medications.

Phase 4 Cardiac Rehabilitation

Phase 4 cardiac rehabilitation begins after the desired functional capacity has been attained (usually greater than or equal to 8 METs) and/or Vo_2max has

reached a plateau. Maintenance is the principal goal. The exercise prescription should continue as at the end of phase 3 unless angina or exercise intolerance develops, either of which requires cessation of exercise and urgent medical attention. Refer to the METs table found in Annotation Appendix F of the original guideline document and the Borg Exertion Scale in Annotation Appendix G of the original guideline document for guidance on setting exercise goals.

Acute Myocardial Infarction Complications Algorithm Annotations

34. Arrhythmic Complication(s)?

    Arrhythmic complications include sinus bradycardia, Möbitz I (Wenkebach) or II block, complete heart block or asystole, premature ventricular contractions (PVCs) and ventricular tachycardia or fibrillation, accelerated idioventricular rhythm, and supraventricular arrhythmias (atrial flutter, atrial fibrillation, supraventricular tachycardia).

35. Treat Arrhythmic Complication(s)

    Advance Cardiac Life Support (ACLS) guidelines provide in-depth descriptions of short-term treatment. For sinus bradycardia and Möbitz I blocks, atropine sulfate is used only if symptoms are present. Möbitz I blocks are common and usually benign in inferior myocardial infarction. Treatment of Möbitz II, complete heart block, or asystole (bradycardia < 60 beats/min) with serious signs or symptoms consists of atropine 0.5 to 1 mg (Möbitz II and IIa); transcutaneous pacing, if available (Möbitz I); dopamine hydrochloride (Intropin), 5 to 20 micrograms/kg/minute (Möbitz IIb); epinephrine (adrenaline chloride, Epipen®, Sus-Phrine®), 2 to 10 micrograms/minute (Möbitz IIb); and isoproterenol hydrochloride (Isuprel®), 0.1 to 1.0 micrograms/kg/minute. Placement of a temporary pacemaker, particularly atrioventricular sequential placing, which may give a better hemodynamic response, should be considered; a permanent pacemaker may be appropriate in cases of anterior MI.

    If ventricular tachycardia or fibrillation occurs more than 24 hours after onset of MI and is not associated with reinfarction or ischemia, angiography and/or electrophysiologic evaluation and testing should be considered. Accelerated idioventricular rhythm is usually benign and should not be treated.

    Supraventricular arrhythmias are rarely life-threatening. Cardioversion is appropriate if the patient's condition is unstable. Beta-blockers remain the drug of first choice. Digoxin may be beneficial in atrial fibrillation if CHF is present or hypotension limits the use of more effective rate controlling agents. Intravenous amiodarone is the most appropriate anti-arrhythmic in this setting. Diltiazem (oral or IV) is only preferred for rate control in patients who cannot take beta-blockers. Adenosine (Adenocard®) may terminate paroxysmal supraventricular tachycardia (PSVT), uncommon arrhythmia in AMI, or unmask atrial flutter, but is ineffective for treating atrial fibrillation.

36. Ischemic Complication(s)?

Ischemic complications include postinfarction angina.

37. Treat Ischemic Complication(s)

Treatment of postinfarction angina should be correlated with ECG changes, if possible. Optimal therapy consists of beta-blockers and long-acting nitrates. If beta-blockers are not tolerated or are ineffective and LV function is not significantly depressed, a calcium channel blocker may be used. Early coronary angiography should be considered. Angina after MI may be confused with pericarditis. Aneurysm formation should be a consideration.

38. Mechanical Complication(s)?

Mechanical complications may include papillary muscle dysfunction or rupture with significant mitral regurgitation, ventricular septal rupture, myocardial rupture, right ventricular infarction, pericarditis with or without tamponade, LV dysfunction, and aneurysm formation.

39. Treat Mechanical Complication(s)

Papillary muscle dysfunction is evidenced by the murmur of mitral regurgitation, typically within 5 days of infarction. It is caused by ischemia or partial infarction of the papillary muscle.

Papillary muscle rupture is a complication of transmural infarction that may occur within 10 days of the event. Findings include development of sudden CHF or pulmonary edema, often but not always accompanied by a new holosystolic apical murmur. Diagnosis is verified by echocardiography revealing a partially or completely ruptured papillary muscle and by Doppler color flow imaging demonstrating severe mitral regurgitation. Stabilization is achieved by one or more of the following: aggressive use of diuretics and vasodilators, insertion of a Swan-Ganz catheter, insertion of an intraortic balloon pump (IABP). Because of the high mortality rate with this complication, urgent surgical repair is indicated after coronary angiography.

Ventricular septal rupture (VSR) occurs within 1 week of infarction and results in left-to-right shunting and subsequent hemodynamic deterioration. Patients at increased risk are those experiencing their first MI with poorly developed collateral vessels to the septum. Ventricular septal rupture is suggested by the presence of a new, harsh, holosystolic murmur that is loudest along the lower left sternal border; this is accompanied by a thrill in about 50% of patients. Patients may also have symptoms of right-sided heart failure with right ventricular (RV) Po_2 step-up and may have less pulmonary congestion than patients with papillary muscle rupture. The diagnosis is confirmed by two-dimensional echocardiography with Doppler color flow imaging. Patients are best stabilized by vasodilator therapy, insertion of a Swan-Ganz catheter or an intraaortic balloon pump, or all of these. Because of the high mortality rate, urgent surgical repair is indicated after angiography.

Myocardial rupture is a common cause of sudden death after AMI. Those at high risk for rupture are elderly patients with no significant cardiac history,

patients with first transmural infarctions, and patients who present at the hospital 6 to 12 hours after onset of symptoms. Symptoms or findings include emesis, persistent restlessness, anxiety, and persistent ST-wave elevation on ECG. Rupture usually occurs within 5 to 7 days of MI. LV free-wall rupture leads to hemopericardium and subsequent death from tamponade. Contained rupture may result in formation of a pseudoaneurysm, the outer walls of which are formed by the pericardium and mural thrombus. Surgical resection is recommended.

Right ventricular infarction is suspected in patients with inferior infarction complicated by low cardiac output, hypotension, oliguria, jugular venous distention, and clear lung fields without radiographic evidence of pulmonary venous congestion. Infarction can be confirmed by electrocardiogram findings (ST-segment elevation in right precordial leads V_4R through V_6R in the presence of inferior ST elevation), two-dimensional echocardiography demonstrating a disproportionate elevation of right atrial pressure compared with pulmonary capillary wedge pressure. Treatment consists of intravascular volume expansion and use of inotropic agents; if the patient loses sinus rhythm, temporary pacing to re-establish atrioventricular synchrony should be considered. Agents that reduce right ventricular preload, such as nitroglycerin, diuretics, and large doses of morphine, should be avoided. ACE inhibitors and beta-blockers may require dose reduction or discontinuation with milder presentation of right ventricular dysfunction post-myocardial infarction.

Post-MI pericarditis can be early (occurring within 72 to 96 hours after acute myocardial infarction) or delayed (typically occurring weeks after MI); the latter is called Dressler's Syndrome. Early pericarditis is suspected in patients with pericardial friction rub, usually heard on the second or third day after AMI, and chest pain that may extend to the back, neck, or shoulders that is intensified by movement and respiration and relieved by sitting up or leaning forward. Treatment consists of anti-inflammatory agents and reassurance. Echocardiography to assess for possible incomplete myocardial rupture should be considered. Echocardiography frequently fails to demonstrate a pericardial effusion in the presence of pericarditis. Pericarditis is common, but effusion is rare following myocardial infarction. It is important to emphasize to the patient that the recurrent pain is not the result of recurrent infarction. Risk of hemopericardium is increased in patients receiving anticoagulants; development of a pericardial effusion can be detected by close clinical observation and echocardiography. Large pericardial effusion is characterized by cardiac silhouette on x-ray films, pulsus paradoxus, muffled heart tones, and increasing shortness of breath.

Dressler's Syndrome, which is much less common than early pericarditis, is characterized by delayed signs and symptoms, and increase in erythrocyte sedimentation rate, leukocytosis, and more frequent pleural and pericardial effusions than in early pericarditis. Because of the increased incidence of pericardial effusion, anticoagulation should be used with caution. Treatment for pericardial effusion with impending tamponade is pericardiocentesis, preferably guided by echocardiography.

Risk of developing left ventricular dysfunction and subsequent CHF is greatly increased in patients with more extensive myocardial infarction. Patients who have an ejection fraction of less than 40% are considered to have severe LV dysfunction but may show no overt signs of heart failure. Patients with LV dysfunction may not show signs of heart failure until months or years later, and their mortality rate is less than that of patients with symptoms that begin soon after a myocardial infarction. Restricted diastolic filling patterns on echocardiography may predict subsequent clinical CHF.

<u>Definitions</u>:

Evidence Grading System: Classes of Research Reports

A. Primary Reports of New Data Collections:

Class A

- Randomized, controlled trial

Class B

- Cohort study

Class C

- Non-randomized trial with concurrent or historical controls
- Case-control study
- Study of sensitivity and specificity of a diagnostic test
- Population-based descriptive study

Class D

- Cross-sectional study
- Case series
- Case report

B. Reports that Synthesize or Reflect upon Collections of Primary Reports

Class M

- Meta-analysis
- Systematic review
- Decision analysis
- Cost-effectiveness study

Class R

- Consensus statement
- Consensus report

C. Narrative review

Class X

- Medical opinion

CLINICAL ALGORITHM(S)

Detailed and annotated clinical algorithms are provided for:

- [Treatment of Acute Myocardial Infarction](#)
- [Acute Myocardial Infarction Complications](#)

<div style="background:teal;color:white">EVIDENCE SUPPORTING THE RECOMMENDATIONS</div>

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The guideline contains an annotated bibliography and discussion of the evidence supporting each recommendation. The type of supporting evidence is classified for selected recommendations (see "Major Recommendations").

<div style="background:teal;color:white">BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS</div>

POTENTIAL BENEFITS

- Appropriate and timely management of patients with acute myocardial infarction (AMI) and its complications
- Increased survival rate in patients with AMI
- Decreased rate of recurrent myocardial infarction (MI)
- Increased rate of tobacco use assessment and cessation counseling and treatment within 24 hours of admission in patients with AMI who have used tobacco products within the past year.
- Increased rate if appropriate use of cardiac rehabilitation post discharge in patients with AMI.

Subgroup(s) Most Likely to Benefit

Patients who are at increased risk of adverse prognosis after acute myocardial infarction

POTENTIAL HARMS

- Thrombolytics such as streptokinase and tissue plasminogen activator (tPA) can increase the incidence of bleeding, notably intracranial bleeding.
- Heparin is also associated with bleeding complications, especially when used in conjunction with streptokinase or glycoprotein IIb/IIIa platelet inhibitors.
- Calcium channel blockers can compound the toxicity of beta-blockers or digoxin.
- Beta-blockers should be used with caution in overt asthmatics, or in combination with non-dihydropyridine calcium channel blockers due to the risk of adverse effects.

CONTRAINDICATIONS

Thrombolysis

Absolute Contraindications

- Previous hemorrhagic stroke at any time: other strokes or cerebrovascular events within one year
- Known intracranial neoplasm
- Active internal bleeding (does not include menses)
- Suspected aortic dissection

Cautions/Relative Contraindications

- Severe uncontrolled hypertension on presentation (blood pressure >180/110 mm Hg)
- History of prior cerebrovascular accident or known intracerebral pathology not covered in contraindications
- Current use of anticoagulants in therapeutic doses (International Normalized Ratio ≥2.0 to 3.0); known bleeding diathesis
- Recent trauma (within 2 to 4 weeks), including head trauma
- Noncompressible vascular punctures
- Recent internal bleeding
- For streptokinase/anistreplase: prior exposure (especially within 5 days to 2 years) or prior allergic reaction
- Pregnancy
- Active peptic ulcer
- History of chronic hypertension

Glycoprotein IIb-IIIa Platelet Inhibitors

- Relative contraindications to the use of glycoprotein IIb-IIIa receptor inhibition are similar to the contraindications for thrombolytics. Increased international normalized ratio (INR) and thrombocytopenia are specific relative contraindications.
- Agents are contraindicated or require dose adjustment for renal dysfunction.

Calcium Channel Blockers

- Calcium channel blockers are contraindicated for patients with reduced ejection fraction or congestive heart failure (CHF).
- Short-acting dihydropyridine calcium channel blockers (e.g., nifedipine) may be associated with increased risk and should be avoided in acute ischemic syndromes.

Beta-blockers

Relative contraindications include systolic blood pressure <100 mg Hg, heart rate <60/min, reactive airway disease, and heart block greater than first degree.

Additionally, beta-blockers should be used cautiously in overt asthmatics or in combination with non-dihydropyridine calcium channel blockers.

Antiplatelets

- Aspirin should be withheld only from patients with true anaphylactic allergy.
- If clopidogrel is given and coronary artery bypass surgery planned, clopidogrel should be held for 5 days prior to surgery due to increased risk of perioperative bleeding.

Nitrates

Hypotension and or bradycardia may occur more often with nitrate use in patients with inferior myocardial infarction.

Magnesium

Magnesium should be used with caution in patients with reduced renal function, hypotension, or greater than first-degree heart block.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

These clinical guidelines are designed to assist clinicians by providing an analytical framework for the evaluation and treatment of patients, and are not intended either to replace a clinician's judgment or to establish a protocol for all patients with a particular condition. A guideline will rarely establish the only approach to a problem.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

Once a guideline is approved for release, a member group can choose to concentrate on the implementation of that guideline. When four or more groups choose the same guideline to implement and they wish to collaborate with others, they may form an action group.

In the action group, each medical group sets specific goals they plan to achieve in improving patient care based on the particular guideline(s). Each medical group shares its experiences and supporting measurement results within the action group. This sharing facilitates a collaborative learning environment. Action group learnings are also documented and shared with interested medical groups within the collaborative.

Currently, action groups may focus on one guideline or a set of guidelines such as hypertension, lipid treatment and tobacco cessation.

The following detailed measurement strategies are presented to help close the gap between clinical practice and the guideline recommendations.

Priority Aims and Suggested Measures for Health Care Systems

1. Minimize the delay in administering thrombolytics or angioplasty to patients with acute myocardial infarction (AMI).

    Possible measures of accomplishing this aim:

    a. Percentage of patients with AMI receiving thrombolytics with a "door to drug time" (time from presentation to administration of drug) of less than 30 minutes.
    b. Percentage of patients with AMI receiving angiogram/primary percutaneous coronary intervention (PCI) with a presentation to catheterization laboratory time of less than 90 minutes (target = less than 60 minutes).

2. Increase the timely initiation of treatment to reduce post-infarction mortality in patients with AMI.

    Possible measures of accomplishing this aim:

    a. Percentage of patients with AMI receiving beta-blockers initiated prior to discharge, for whom this treatment is appropriate.
    b. Percentage of patients with AMI placed on prophylactic aspirin initiated prior to discharge, for whom this treatment is appropriate.
    c. Percentage of patients with AMI receiving angiotensin-converting enzyme (ACE) inhibitors initiated prior to discharge, for whom this treatment is appropriate.
    d. Percentage of patients with AMI receiving statin agent initiated prior to discharge, for whom this treatment is appropriate.

3. Increase the use of risk stratifying procedures in patients with AMI.

    Possible measures of accomplishing this aim:

    a. Percentage of patients with AMI receiving or scheduled for a risk stratifying procedure prior to discharge.
        - Echocardiogram
        - Angiogram
        - Stress test (treadmill test)

4. Increase the percentage of patients with AMI, who have used tobacco products within the past year, who receive tobacco use assessment and cessation counseling and treatment within 24 hours of admission.

    Possible measure for accomplishing this aim:

    a. Percentage of patients with AMI who have used tobacco products within the past year, who receive tobacco use assessment and cessation counseling and treatment within 24 hours of admission that is documented in the medical record.

5. Increase the percentage of patients with AMI using appropriate cardiac rehabilitation post discharge.

   Possible measures of accomplishing this aim:

   a. Percentage of patients with AMI who received post discharge cardiac rehabilitation including dietary instruction, tobacco cessation, and a manageable exercise regimen.
   b. Percentage of patients with AMI who are using appropriate cardiac rehabilitation.

   Phase 2 Programs: Electrocardiogram (ECG)-monitored, outpatient

   Phase 3 Programs: non-monitored, outpatient

Possible Success Measure #1a

Percentage of patients with AMI receiving thrombolytics with a "door to drug time" (time from presentation to administration of drug) of less than 30 minutes.

Population Definition

Adults 18 and older diagnosed as having an acute myocardial infarction.

Data of Interest

Formula for calculating door to drug time

Time of initiation of thrombolytic therapy to patient with AMI
MINUS Time of arrival of patient with AMI in the emergency department
EQUALS Door to drug time in minutes

Numerator/Denominator Definitions

Numerator:
# of patients with AMI receiving thrombolytics within 30 minutes of presentation in the emergency department. (All reportable times are rounded to the nearest minute.)

Denominator:
# of patients with AMI receiving thrombolytics in the emergency department in the measurement period.

Methods/Source of Data Collection

Plan A: It is suggested that data collection be completed on a real-time basis. This measure references all patients to improve process sensitivity at sites where few AMI patients are routinely discharged in a given measurement period.

Plan B: Should real time data collection present insurmountable institutional obstacles, consider using the principal diagnosis codes (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM]) presented in the original guideline document for identification of patient records for abstracting.

Sites may use the AMI patient record in the original guideline document as a stand-alone data collection tool. It is recommended that any Emergency Department collection document used be routed to a central clinical/hospital liaison at the time of patient discharge, and that all routing be independent of the patient medical record. Data collection forms can be forwarded to the medical group for analysis.

In addition to tracking the percentage of patients treated in less than 30 minutes, sites may choose to also track either the mean (average) or the median (middle point) of the data. Using the median is preferred. The median is the value of the middle item in the data set. The median value is preferred over the mean (average) value because it minimizes the impact of outlying data points. For example, if one case of receiving thrombolytics took 120 minutes when the other 10 cases in the data set received them within 20 to 30 minutes, then the mean would be about 34 minutes. However, the median for that same data set might be around 26 minutes, and would more accurately reflect the usual performance of the system.

Time Frame Pertaining to Data Collection

Data can be collected weekly or monthly.

Notes

The rationale for development of this measure included several elements. First, multiple authors have identified time to thrombolytics administration as one key to reducing mortality in acute myocardial infarction. The 1995 Joint Commission for the Accreditation of Hospital Organizations (JCAHO) hospital accreditation organization and the U.S. Health Care Financing Administration (HCFA)*-Cooperative Cardiovascular Project both audit hospital efforts for improving the care of AMI patients. Time to thrombolysis is an important measure in that the resulting statistics would have great sensitivity to process changes, even in facilities with small numbers of patients with AMI. The percentage of patients receiving thrombolytics within 30 minutes should increase over time if the guideline is successfully implemented. This is an important success measure. (*The U.S. Health Care Financing Administration is currently known as the Centers for Medicaid and Medicare Services.)

Possible Success Measure #2a

Percentage of patients with AMI receiving beta-blockers no later than discharge.

Population Definition

Adults 18 and older diagnosed as having an AMI.

Data of Interest

<u># of patients with AMI receiving one or more beta-blockers no later than discharge</u>
# of patients with AMI discharged in the measurement period

Numerator/Denominator Definitions

Numerator:
# of patients with AMI receiving beta-blockers no later than discharge

Denominator:
# of patients with AMI discharged in the measurement period

Method/Source of Data Collection

Plan A: It is highly recommended that data collection be completed on a real-time basis. This measure references all patients to improve process sensitivity at sites where few patients with AMI are routinely discharged in a given time period.

Plan B: Should real-time data collection present insurmountable institutional obstacles, consider retrospective chart review of all or a simple random sample of records of patients with AMI. A random sample is best employed in the presence of more than 30 discharges in a measurement period. If fewer than 30 discharges occur in a measurement period, consider examining all the records.

The original guideline document contains a listing of AMI medications with relevant trade names and National Drug Code (NDC) codes.

Sites may use the AMI patient record included as an attachment to the original guideline document as a stand-alone data collection tool. It is recommended that any inpatient collection document used be routed to a central clinical/hospital liaison at the time of patient discharge, and that all routing be independent of the patient medical record. Data collection forms can be forwarded to the medical group for analysis.

Time Frame Pertaining to Data Collection

Data can be collected weekly or monthly.

Notes

The rationale for development and reporting of this measure included two elements. Multiple post-myocardial infarction studies (Gusto, CCP) have shown that approximately half of the patients in which beta-blockers are indicated are actually given the drug. Multiple authors have identified under-utilization of beta-blockers as potentially increasing the likelihood of reinfarction and (as a result) increasing mortality rates. The U.S. Health Care Financing Administration (HCFA)*-Cooperative Cardiovascular Project audits use of beta-blockers in assessing hospital efforts for improving the care of acute myocardial infarction patients. This rate should increase over time. (*The U.S. Health Care Financing

Administration is currently known as the Centers for Medicaid and Medicare Services.)

Possible Success Measure #3a

Percentage of patients with AMI receiving or scheduled for a risk stratifying procedure prior to discharge.

Population Definition

Adults 18 and older diagnosed as having AMI.

Data of Interest

<u># of patients with AMI receiving or scheduled for a risk stratifying procedure</u>
total # of patients with AMI discharged in the measurement period

Numerator/Denominator Definitions

Numerator:
# of patients receiving or scheduled for an echocardiogram, angiogram or stress test (treadmill test) prior to discharge

Denominator:
# of patients with AMI discharged in the measurement period

Method/Source of Data Collection

Plan A: It is suggested that data collection be completed on a real-time basis. This measure references all patients to improve sensitivity at sites where few AMI patients are routinely discharged in a given time period.

Plan B: Should real time data collection present insurmountable institutional obstacles, consider using the principal diagnosis codes (International Classification of Diseases, Ninth Revision, Clinical Modification) presented in the original guideline document for identification of patient records for abstracting.

Sites may use an AMI patient record that is included as an attachment to the original guideline document as a stand-alone data collection tool. It is recommended that any inpatient collection document used be routed to a central clinical/hospital liaison at the time of patient discharge, and that all routing be independent of the patient medical record. Data collection forms can be forwarded to the medical group for analysis.

Time Frame Pertaining to Data Collection

Data can be collected weekly or monthly.

Probing Measures

1. Times to initiate 12 lead ECG on patients suspected of AMI
2. Time (in minutes) from ECG initiation to decision to treat with thrombolytics
3. Time from decision to treat to initiation of thrombolytics

Other Implementation Success Measures

1. Length (in days) of hospitalization for patients with AMI
2. Percentage of patients with AMI receiving an assessment of ejection fraction
3. Percentage of patients with AMI receiving percutaneous transluminal coronary angioplasty (PTCA) or coronary artery bypass graft (CABG)
4. Percentage of patients with AMI risk stratified to high risk for reinfarction
5. Percentage of patients with AMI whose records documenting the discussion of ALL cardiac risk factors

Systems Approaches to Implementation

1. Hospitals should consider developing and implementing Emergency Department critical pathways and standing orders to accomplish rapid evaluation and treatment of AMI. Standard discharge orders/instructions should also be considered.
2. A process should be in place for the patient and family that will rapidly orient them to the suspected diagnosis, Emergency Department, and Critical Care Unit process and other treatment measures to be considered. This could include both caregiver face-to-face interactions with the patient and family as well as teaching tools in written form.
3. Institutions that cannot meet the recommended treatment times for primary percutaneous coronary intervention (PCI) should consider preferential use of intravenous thrombolytic therapy. These institutions should have a predetermined plan for treating patients who present with contraindications to thrombolytics. Such plans may employ delayed local primary PCI or transfer to another institution.

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IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness
Timeliness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Institute For Clinical Systems Improvement (ICSI). Treatment of acute myocardial infarction. Bloomington (MN): Institute For Clinical Systems Improvement (ICSI); 2002 Nov. 68 p.

ADAPTATION

Not applicable: The guideline was not adapted from another source.

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GUIDELINE DEVELOPER(S)

Institute for Clinical Systems Improvement - Private Nonprofit Organization

GUIDELINE DEVELOPER COMMENT

Organizations participating in the Institute for Clinical Systems Improvement (ICSI): Affiliated Community Medical Centers, Allina Medical Clinic, Altru Health System, Aspen Medical Group, CentraCare, Columbia Park Medical Group, Community-University Health Care Center, Dakota Clinic, ENT SpecialtyCare, Fairview Health Services, Family HealthServices Minnesota, Family Practice Medical Center, Gateway Family Health Clinic, Gillette Children's Specialty Healthcare, Grand Itasca Clinic and Hospital, HealthEast Care System, HealthPartners Central Minnesota Clinics, HealthPartners Medical Group and Clinics, Hutchinson Area Health Care, Hutchinson Medical Center, Lakeview Clinic, Mayo Clinic, Mercy Hospital and Health Care Center, MeritCare, Minnesota Gastroenterology, Montevideo Clinic, North Clinic, North Memorial Care System, North Suburban Family Physicians, Northwest Family Physicians, Olmsted Medical Center, Park Nicollet Health Services, Pilot City Health Center, Quello Clinic, Ridgeview Medical Center, River Falls Medical Clinic, RiverWay Clinics, Saint Mary's/Duluth Clinic Health System, St. Paul Heart Clinic, Southside Community Health Services, Stillwater Medical Group, SuperiorHealth Medical Group, University of Minnesota Physicians

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GUIDELINE COMMITTEE

Cardiovascular Steering Committee

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FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

In the interest of full disclosure, ICSI has adopted a policy of revealing relationships work group members have with companies that sell products or services that are relevant to this guideline topic. It is not assumed that these financial interests will have an adverse impact on guideline content. They simply are noted here to fully inform users of the guideline.

All work group members: none declared.

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previously released version: Treatment of acute myocardial infarction. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2001 Oct. 53 p.

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GUIDELINE AVAILABILITY

Electronic copies: Available from the Institute for Clinical Systems Improvement (ICSI) Web site.

Print copies: Available from Institute for Clinical Systems Improvement, 8009 34th Avenue South, Suite 1200, Bloomington, MN 55425; telephone, (952) 814-7060; fax, (952) 858-9675; Web site: www.icsi.org; e-mail: icsi.info@icsi.org.

AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- Treatment of acute myocardial infarction. In: ICSI pocket guidelines. April 2002 edition. Bloomington (MN): Institute for Clinical Systems Improvement, 2002 Apr. pp. 104-15.

- Cardiac stress test supplement. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2001 Oct. 24 p.
- Anticoagulation therapy supplement. Bloomington (MN): Institute for Clinical Systems Improvement (ICSI); 2002 Oct.

Electronic copies: Available from the Institute for Clinical Systems Improvement (ICSI) Web site.

Print copies: Available from ICSI, 8009 34th Avenue South, Suite 1200, Bloomington, MN 55425; telephone, (952) 814-7060; fax, (952) 858-9675; Web site: www.icsi.org; e-mail: icsi.info@icsi.org.

PATIENT RESOURCES

None available

NGC STATUS

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